Some Observations on the Tentacles of *Blennius gattorugine*. By H. A. Baylis, B.A., of Jesus College, Oxford. (Communicated by Prof. G. C. Bourne, F.R.S., Sec.L.S.)

(Plates 22 & 23, and 1 Text-figure.)

[Read 15th January, 1914.]

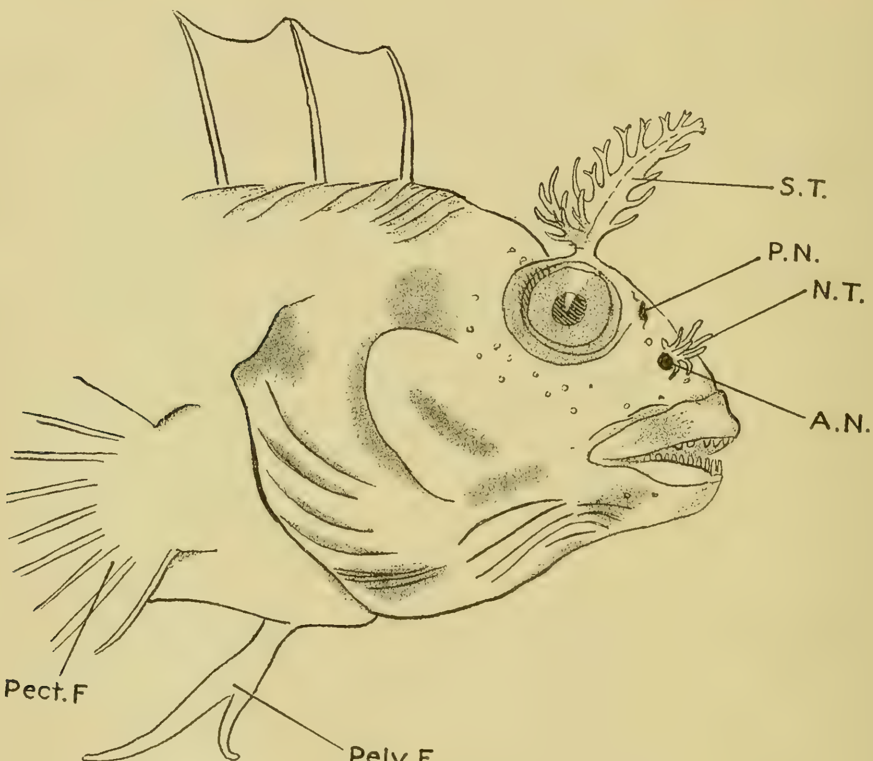
While examining the cutaneous sense-organs of the barbels and other appendages of various fishes at Naples, it occurred to me that the tentacles of this remarkable species might provide some facts of interest; and though previous observers have not, so far as I have been able to discover, noted any peculiar sense-organs in these appendages, I did not feel satisfied that tentacles of such peculiar shape and appearance could have become a characteristic feature of the species without performing some special function. My investigations have not made it clear what that function actually is, but it does appear to me that sense-organs of at least one kind are present, and this is my excuse for publishing the following remarks.

The head of *Blennius gattorugine* bears two pairs of branched appendages (see text-figure). The larger pair, situated on the top of the cranium, immediately above the eyes, may be called the supraorbital tentacles. It is with these that my account is chiefly concerned. The smaller pair are situated on the posterior edge of the somewhat tubular anterior nostrils, forming a kind of fringe of filaments overhanging the nostril on either side.

As far back as 1872 M. Jobert [2] published an account of the general structure of the large tentacles, from a study of transverse sections, as well as a general description of their form. I need therefore only remark, as to their shape, that they consist of a slightly tapering stem, flattened laterally, with numerous smaller branches, or "filaments ascendants," as M. Jobert calls them, along its anterior and posterior edges. The branches, in their turn, often give off still smaller twigs, especially those nearest to the base of the tentacle and posterior to it. M. Jobert mentions that the tentacles were about 2 cm. in length in the specimen examined by him, but in those which I have studied they are considerably smaller (about 11–12 mm.).

When the fish is in water, the tentacles stand up vertically, apparently rigid, looking like a pair of elaborately branched antlers. M. Jobert states that "au centre se trouve une sorte de charpente de tissu conjonctif très-dense, qui permet de les maintenir, même hors de l'eau, à l'état de demi-érection." This may be the case in very fully developed specimens, but I find that in mine the tentacles are limp, and lie down flat on the head when the animal is taken out of water.

The tentacles are capable of a certain amount of motion, but are not supplied with special muscles, and move, I think, only in correspondence with the movements of the eyes. If an object, such as a glass rod, is made to approach the head of a normal Blenny, the tentacle on the side nearest to it may sometimes be seen to move slightly away from it, but at the same time the eye is turned upwards to examine the intruding object, and the motion of the tentacle does not appear to take place in specimens which have been



Head of *Blennius gattorugine*. × 2.
A.N., anterior nostril. N.T., nasal tentacle. Pect. F., pectoral fin. Pelv. F., pelvic fin. P.N., posterior nostril. S.T., supraorbital tentacle.

blinded by cutting the optic nerves. The significance of this fact will be seen later, in inquiring into the possible function of the tentacles.

When cut off, the tentacles appear to be readily regenerated. In this species the regenerated parts show signs of branching while still very small; the pigment is at first very scanty. This is in curious contrast to the process in *B. ocellaris*, in which the regenerated parts remain unbranched for a long time, though attaining a considerable size, and being quite deeply pigmented.

Microscopic Structure.

In sections, either transverse or longitudinal, the centre of the tentacle is seen to be occupied by numerous bundles of medullated nerve-fibres, which, as M. Jobert has shown, are offshoots from the supra-ophthalmic branch of the Vth nerve. These bundles are accompanied by small blood-vessels, which run parallel to them, and in some cases even appear to be partly surrounded by them. Branches are sent off from this central and very abundant nerve-supply to the various lateral twigs of the tentacle. These nerves and vessels are surrounded by a connective-tissue sheath, and this is succeeded by a more or less dense network of fine connective-tissue fibres, with nucleated cells interspersed. Peripherally there is a dense corium, here and there raised into a small papilla. The outer part of the corium shows a stratified structure, as M. Jobert points out. Internally, however, the corium takes the form of a series of vertically-placed bundles of very fine fibres. In transverse sections the centres of these bundles sometimes give the appearance almost of a little "lens"—probably a mass of some refractive colloid substance (Pl. 22. fig. 2). These vertical bundles give the corium, in a transverse section, the appearance of being divided into a series of nearly regular blocks; immediately below these there is a layer of very large, branched pigment-cells, densely crowded with granules of pigment, which may be of various colours—yellow, reddish, or nearly black. These cells send their amœboid processes up between the "blocks" of the corium, and it is at this level that the pigment granules are usually most densely crowded (fig. 2).

Starting from the corium externally to the pigment-cells, and passing inwards between them at frequent intervals, at right angles to the longitudinal axis of the tentacle, are seen bundles of connective-tissue strands, which stain deeply with nigrosin. They appear to lose themselves at one end in the corium, and at the other in the connective-tissue sheath of the central nerve-bundles. I was at first led to think that they might be nerve-sheaths, but have not been able to demonstrate nerve-fibres running through them, and must therefore suppose that they are merely strengthening and supporting structures, helping to render the tentacle more or less rigid. These structures are much more numerous and conspicuous in *B. ocellaris* than in the species under consideration. Their arrangement is indicated in fig. 1.

No doubt the ultimate branches of the nerves lose themselves in a fine network immediately below the pigment layer of the corium. In my preparations, however, it is difficult to distinguish the fibres belonging to this system from those of the ubiquitous connective tissue. My attempts to stain with methylene-blue and with nitrate of silver were signal failures, and though chloride of gold gave useful results in one particular, as I hope to show, yet for this purpose it was equally unsuccessful.

It now remains to describe the structure of the epidermis, and it is chiefly here that my account, I believe, differs from those previously given. M. Jobert was unable to study the epidermis, as it was lacking in the specimen used by him, owing to imperfect fixation. He mentions, however, that on the stem and branches of the tentacle dermal papillæ are present, exactly like those of the barbels of other species, in which they are usually surmounted by taste-buds in the epidermis. One might, therefore, expect to find a taste-bud in this instance wherever there is a papilla. This, however, does not seem to be the case. A. Zincone [5] gives some account of the cellular elements of the epidermis, and a figure of a transverse section of the tentacle. He does not mention the presence of any taste-buds, either on dermal papillæ or anywhere else; but he mentions certain other kinds of cells, to which I shall have occasion to refer later. His figure is rather diagrammatic, and seems to differ somewhat from his description. He does not show, for instance, the "rilievi papillari notevoli" of the dermis; nor any peculiar cells in the epidermis except ordinary mucous cells. Bateson [1] states that he found *no* sense-organs on the "tree-shaped processes standing up from the anterior nostril and orbit of *B. gattorugine*."

Now, it seems to be tolerably clear that the dermal papillæ are not the seat of taste-buds in this case. At the same time, I have noticed in a few of my sections, both in this species and in *B. ocellaris*, little groups of elongated cells extending through the thickness of the epidermis, and having very much the appearance of taste-buds. They do not seem to be arranged on any definite plan, and in fact are so rare that they have the appearance of having "strayed" from a more normal situation. Where they do occur, they always appear between, and not on, the dermal papillæ. In fig. 3 is represented such a group of cells from a tentacle of *B. ocellaris*. The arrangement of the cells in this case seems so definite that I have figured it for comparison with the less convincing example from *B. gattorugine* shown in fig. 4 (Pl. 23). The cells composing these groups do not, it is true, seem quite similar to those of ordinary taste-buds, and they are few in number. But the fact of such groups of cells occurring at all, and of their extending from the basement membrane to an apparently free ending at the surface, is in itself worthy of notice. Unfortunately I have not been able to see whether any nerve-fibres pass to these groups of cells, but it seems probable that such is the case, and that they are sense-organs of some kind, and very possibly true taste-buds.

These, however, are not the only sense-organs which I believe to exist in these appendages. In sections of the tips of the branches, stained with chloride of gold, I have found a great abundance of peculiar elongated cells running through the thickness of the epidermis, and ending distally in a fine though blunt-ended hair-like process. They closely resemble olfactory cells in general appearance, having a rather swollen inner end, containing a comparatively large nucleus. Distally they taper gradually, but appear to end abruptly, while proximally I believe they are connected with fine nerve-fibres. These cells are invisible in preparations stained by ordinary methods, but stain deeply with the gold chloride, with the exception of their nuclei, while the surrounding tissues remain vaguely defined. Fig. 5 gives a general idea of their appearance, while fig. 6 is a drawing of a few of them at a higher magnification, showing how the fine nerve-fibres appear to come into connection with them. These fibres I have been unable to trace through the corium, owing to the dense pigment. On dissolving the pigment by means of Mayer's chlorine bleaching method, the tissues will no longer stain properly. Hence I can only conjecture (and it seems a reasonable hypothesis) that nerve-fibres pass from the network beneath the corium, through the latter, to reach these fusiform cells in the epidermis. In order to establish the existence of these cells more certainly, I have made preparations of them in glycerine by macerating the tentacles with weak alcohol, and also with osmic acid. I hoped also in this way to be able to see more clearly their connection with the nerves, but in this I was disappointed. Fig. 7 is a composite group of a number of these elongated cells, isolated in this way. This method seems to leave little doubt that such cells actually exist as component parts of the epithelium. They are exceedingly numerous, occurring singly among the ordinary cells of the epidermis, and not forming groups as taste-buds. They only occur near the tips of the fine branches, and not on the main stem of the tentacle. This might, perhaps, account for their having been hitherto overlooked.

It is interesting to notice, however, that Zincone, in the paper already cited, has given an account and a figure of certain elongated cells, which he calls "cellule fusiformi," in the epidermis of the free fin-rays of *Trigla*. These cells are connected with nerve-fibres passing through the dermis. He says, "Lo strato epidermoidale riposa sopra una zona di connettivo omogeneo irto di processi papilliformi. Le cellule fusiformi a due poli fanno continuazione non interotta con le papille, e probabilmente raggiungono la cuticola." His figure shows one of these cells with its nerve, but the "probable" connection with the cuticle is only represented by a dotted line. It will readily be seen that these cells have a certain resemblance to the elongated cells in *Blennius*; but to what extent they are homologous (or analogous) with them is doubtful.

Cells somewhat similar in appearance are also described and figured by Morrill [6] from the free fin-rays of *Prionotus*, another member of the Gurnard family. He appears to have satisfied himself that they are tactile in function, and used in finding food.

I find fusiform cells also in the nasal tentacles of *B. gattorugine*, in sections of the filaments stained with gold chloride. The cells appear to be exactly similar to those in the supra-orbital tentacles, and are equally invisible by other staining methods.

Before leaving the morphological characters of the epidermis, certain other kinds of cells must be mentioned which occur with great frequency among the ordinary stratified epithelium. Zincone mentions two kinds—namely (1) ordinary unicellular mucous glands ("cellule a forma di bottiglia"), which have their narrow ends on a level with the outer surface of the epithelium. His account of these agrees with my observations. As he says, they are not stained by osmic acid or by chloride of gold, but remain as clear, conspicuous, refractive bodies. They have a small nucleus at the bottom of the cell, surrounded by a thin protoplasmic residuum. The greater part of the cell is occupied by the mucous secretion. These are the only cells, apart from the ordinary epithelial cells, shown in his figure. They are particularly abundant near the base of the tentacles. Some of them are shown in outline in my figure 8, and one from *B. ocellaris* in fig. 9 *a*. (2) If I understand him aright, the only other cells alluded to by him are round or oval cells, more deeply imbedded in the epidermis, and staining deeply both with osmic acid and chloride of gold. He says: "Vi sono invece altre cellule di grandezza parimenti notevole, le quali benchè non presentano la forma dei così detti *Kolben* descritti dal Max Schultze e Fr. E. Schulze, ed invece si presentano di una forma ovale, pure subiscono una reazione particolare non commune alle cellule a muco, si colorano cioè fortemente al cloruro d'oro ed all' acido iperosmico." As he suggests, they are probably merely an early stage of the mucous cells, and would later migrate to the surface and acquire the characteristic flask-like shape, with an opening on the exterior. As in their final form, they have an eccentric nucleus surrounded by a little residual protoplasm, and the rest of the globular cell is swollen out with the secreted matter, which becomes deep black when treated with osmic acid. With ordinary methods of staining, such as borax-carmine, these cells remain clear. A typical example of such a cell is shown in fig. 9 (*M*). See also figs. 2 and 4 (*M*). Two such cells, treated with osmic acid and isolated, are also shown in fig. 10.

In addition to these two forms of mucous cells, it seems to me that there are also present still more conspicuous cells, which may fairly be compared with the "Kolben" described and figured, especially for *Petromyzon*, by F. E. Schulze [4]. These are very large elongated cells, extending, as a rule, through the whole thickness of the epidermis. In sections they always appear to lie in a space hollowed out in the ordinary stratified epithelium; an appearance which may, perhaps, be due to shrinkage. As Schulze says, there is no apparent membrane surrounding these cells, and they appear to be of a semi-fluid consistency ("dickflüssige Consistenz"); but after hardening, they can easily be isolated by teasing or pressure, and then appear as bodies of a fairly constant, somewhat bottle-shaped form. The mass of the cell appears to be composed of fine, highly refractive granules; it stains rather deeply with carmine, and appears uniformly greyish after treatment with osmic acid. In the centre of this granular mass there is a large nucleus, which often appears to consist of two halves very closely apposed. This peculiarity does not, however, appear to be constant. The double nucleus may be seen in my figures 2 (A, n') and 9 (A). At the outer end of the cell there is always a little clear, cup-shaped hollow, which in my preparations always seems to be open to the exterior [fig. 10 (*c.*) and 9 (*o.*)]. According to Schulze, this hollow, in the "Kolben" of *Petromyzon*, varies considerably in size and position. In some cases he found it as a mere space in the cell, with no external opening. In others it not only had an opening at the outer extremity of the cell, but might even extend inwards as an elongated tubular cavity, tapering to a point towards its proximal end. This appearance I have never observed in my preparations. Schulze is of opinion that the form with closed cavity is an early stage, and that the cavity afterwards acquires an opening and pours a secretion out on the surface of the skin. He finds fat-globules sometimes present in the cavity, but does not seem certain whether these may not be pathological. According to M. Schultze [**3**] (as quoted by Schulze), the "Kolben" of *Petromyzon* often appear to be in close connection with perpendicular strands of connective tissue immediately below the cutis, and these strands often contain a dark fibre which may possibly be a nerve-fibre. He also finds, as does F. E. Schulze, that the Kolben themselves show certain cross-striations, caused by alternate layers of doubly and singly refractive substance, comparable to the appearance of striated muscles.

M. Schultze therefore draws the conclusion that the Kolben are probably "nervöse Endapparate muskulöser Natur."

F. E. Schulze, however, points out that neither the cross-striations nor the intimate connection with the cutis are constant for all fishes in which "Kolben" are found. In *Petromyzon fluviatilis* and the Eel, he says, all the "Kolben" stand on the cutis; but in other fishes examined by him (*Silurus*, *Cobitis*, *Tinca*, and *Leuciscus*) they may occur at all levels in the epidermis and separate from the cutis. Even in another species of Lamprey, described by H. Müller, both these peculiarities of the "Kolben" are absent. Schulze therefore remains undecided as to the nature of these cells, but thinks they are perhaps comparable with the sebaceous glands of mammals, their substance breaking down to form fatty matter, which is discharged as a secretion on the surface of the skin. He thinks that normally the "Kolben" migrate to the surface to perform this function; in *Petromyzon* and the Eel, where they never lose their connection with the cutis and have no actual opening on the exterior, their secretion probably finds its way out between the outer cells of the epidermis. He is also of the opinion that their apparent muscular structure may be for the expulsion of the secretion.

In most particulars the "Kolben," if I may so call them, of the tentacles of *Blennius* agree closely with those of *Petromyzon*; but they nearly always appear to have an opening on the exterior between the outer layer of epidermal cells. I have not observed cross-striations or fat-globules in them, but the double nucleus and the clear cavity are almost always visible. The latter, however, is always open and of a cup-like shape. The "Kolben" usually either touch the cutis at their lower ends, or are only separated from it by protoplasmic processes from the surrounding cells, rarely by any complete cells with nuclei. (Of course, an appearance of this kind may be produced in sections which do not pass quite through the longitudinal axis of the "Kolben.") I have not been able to discover any nerve-fibres in connection with them, and do not think that they ever form any connection with my vertical connective-tissue "blocks."

As regards the function of the tentacles, and especially of the peculiar cells previously described, which seem to me to be undoubtedly sensory, I am not in a position to make any definite statement. Apart from morphological considerations, which would lead one to suppose that these cells might be olfactory in function, the only means of investigating this question is the experimental method. There are, however, great difficulties in the way of reaching any certain conclusions by this means. Thus, even if one could prove that the fish recognized the presence of food or of chemical substances by the use of their tentacles, by cutting off all other avenues of perception, it would be well-nigh impossible to say whether the sensation appreciated was one of smell, of taste, or of what G. H. Parker, in a recent paper, has termed the "common chemical sense." The few experiments which I have made in this direction are not of much value for this reason. I tested a few normal specimens first with certain reagents, with a view to finding out whether the tentacles were sensitive to them. In each case a small pellet of wool was dipped in the reagent, and then (first) held over or near the tentacles in the water, and (secondly) lightly brushed against them. To oil of cloves there was no perceptible reaction. Acetic acid caused a rapid retreat on the part of the fish; they backed away as soon as the diffusing acid reached them, and without being touched by the pellet. But the movements of the mouth and opercula showed that some of the acid had got into the mouth. Hydrochloric acid produced similar results. Caustic soda seemed to have a decided effect when placed near the tentacles, the fish darting away at once. When some of the white precipitate formed entered the mouth, the fish backed a little and spat it out, but did not dart away. Caustic ammonia did not produce any marked effect when presented to the tentacles, but the fish did not seem to like it when presented in front of their snouts. Now it cannot be shown from these experiments that the reactions may not have been due to the stimulation of the free nerve-endings in the skin of the head, or of taste-buds situated either in the mouth or elsewhere. There is no proof that any of the reactions were due to the stimulation of organs in the tentacles alone.

As a further test, three specimens were etherized, and in two of them the optic nerve on either side, and the olfactory tracts, were cut. In the third the olfactory tracts only were severed. These specimens still reacted to chemical agents, such as acetic acid, as might be expected, but this fact is of no value. Their tentacles were very sensitive to touch, especially in those whose optic nerves had been cut. After a rest of some four days, to allow of recovery from the effects of the operation, the three fishes were placed in a small aquarium and tested with worms and pieces of worms. The two which had been blinded showed no sign of noticing the food when placed on the bottom of the vessel near their snouts or eyes. The unblinded specimen showed signs, as might be expected, of perceiving them by sight. When pieces were lightly brushed against their tentacles, all three specimens at first backed away, as if reacting to an ordinary touch-stimulus. One of the blinded individuals, however, appeared to recognize the presence of food. He made a feeble snap at it, but did not swallow it. In fact, none of them fed at all. After two or three trials they ceased to react at all to the stimulus of touch applied to the tentacles. As a control, three normal specimens were fed in the same vessel, two of which fed readily. On the two following days the same procedure was gone through, with similar results. I am inclined to believe that in the one fish which seemed to recognize food the olfactory function may not have been completely destroyed.

The only conclusions with regard to the tentacles which it is possible to deduce from the above meagre evidence are :—

(1) That the tentacles are very sensitive to touch.

(2) That they *may* recognize the "feel" (? the taste or odour) of the substance that touches them. This, however, is very doubtful.

As to the normal function of the tentacles, therefore, I am still undecided. The only fact which seems tolerably certain is that they contain *some* nervous apparatus which is eminently sensitive to touch, whether the stimulus comes from an article of food or an inanimate object. Thus, normal specimens whose tentacles are lightly touched with a glass rod as they lie on the bottom of an aquarium, will lean over in an almost ludicrous manner away from the side touched, at the same time moving their eyes to see the source of irritation. Whether my fusiform cells play any part in the perception of this kind of stimulus is a question which I must leave unanswered.

It would have been interesting if it could have been shown that the tentacles were sensitive to disturbances or vibrations in the water, due to the movements of other animals or to deliberate stirring by artificial means. From the habit shown by these fishes of lying half concealed among rocks and stones, often with only the head exposed and the tentacles erect, this would almost seem a likely function. I have not, however, been able to find any evidence that such is the case *. Of course, there is always the possibility that such appendages may serve merely to increase the resemblance of the animal to its surroundings by simulating bits of seaweed and the like, or by merely breaking the continuity of its outline, as is no doubt the case among various fishes, such as *Scorpæna*. But this offers no explanation of the presence of special sense-organs in the tentacles, and could not, therefore, in this case be considered the sole justification for their existence.

NOTE.—In *Blennius ocellaris* somewhat similar supraorbital tentacles are found, but they are more flattened in shape, with expanded extremities. They do not appear to contain any fusiform cells, though in other respects their histology closely resembles that of the tentacles of *B. gattorugine*. There are no nasal tentacles, but there is a small flattened dermal appendage on the back, on either side of the first or anterior ray of the dorsal fin. In sections of these appendages no fusiform cells or taste-buds were found, but there are a very few "Kolben" and numerous globular mucous cells. The corium is very thick, and consists of fine fibres arranged in a conspicuously concentric manner, with large vertical bundles internally. The connective tissue in the centre of the organ is rather loose, with a few small nerve-bundles running longitudinally through it.

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* Mr. C. Tate Regan, of the British Museum, has suggested to me that these tentacles might serve to gauge the amount of space in the crannies of rocks such as these fishes love—much as the whiskers of cats, to quote a familiar case, are supposed to gauge spaces through which they creep.

EXPLANATION OF THE PLATES.

Plate 22.

Fig. 1. A transverse section of the main stem of a tentacle of *Blennius gattorugine*; low power. Partly diagrammatic.

a, One of the "Kolben." *b*, blood-vessels. *C.*, corium. *C.T.*, the deeper connective tissue. *Ep.*, epidermis. *F.*, one of the radially-disposed bundles of connective-tissue fibres. *m.*, mucous cells (round form). *N.*, nerve-bundles. *P.*, pigment. *Pa.*, dermal papillæ.

Fig. 2. A small portion of the edge of a transverse section of the same.

A, "Kolbe." *C.*, the outer layer of columnar epithelium. *Co.*, corium. *L.*, "lens-like" body in perpendicular column of connective tissue. *M.*, round form of mucous cell. *P.*, pigment-cell. *n.*, nucleus of pigment-cell. *n.'*, double nucleus of Kolbe. Cam., oil imm. $\frac{1}{12}''$, oc. ×8.

Fig. 3. *Blennius ocellaris.* Small portion of the skin of the tentacle in longitudinal section.

C., Stratified outer part of corium. *Cu.*, cuticle. *Ep.*, epidermis. *T.*, group of elongated cells, possibly a taste-bud. Cam., oil imm. $\frac{1}{12}''$, oc. ×8.

Plate 23.

Fig. 4. *Blennius gattorugine.* Portion of transverse section of the stem of a tentacle.

T., A group of elongated cells (taste-bud?). Other letters as in fig. 2. Cam., oil-imm. $\frac{1}{12}''$., oc. ×8.

Fig. 5. *Blennius gattorugine.* Part of the edge of a transverse section of one of the "twigs" of a tentacle, stained with gold chloride.

C., Corium. *C.T.*, connective-tissue and nerve-fibres. *E.*, end-cell. *Ep.*, epidermis. *h.*, hair-like termination of end-cell. *n.*, nerve-fibres. *P.*, pigment. Cam., oil-imm. $\frac{1}{12}''$, oc. ×5.

Fig. 6. Portion of a similar section, more highly magnified.

Lettering as in fig. 5. *E.'*, end-cells cut obliquely or to one side.

Fig. 7. Isolated elements of the epithelium of the tentacle of *B. gattorugine.*

(Macerated in weak alcohol, stained with picrocarmine, and examined in glycerine.)

E., End-cells. *Ep.*, ordinary epiderm-cells. *E.'*, an end-cell with bifurcated base. *d.*, distal extremity of end-cell. *n.*, proximal end, with minute nerve-fibre. *n'.*, nucleolus. Cam., obj. $\frac{1}{6}''$, oc. ×8.

Fig. 8. *B. gattorugine.* Part of a longitudinal section near the base of a tentacle prepared with osmic acid.

a, clear flask-shaped mucous cells, occurring only near the base. *b*, round form of mucous cells, blackened with osmic acid. Other lettering as before. Obj. $\frac{1}{6}''$, oc. × 5.

Fig. 9. *B. gattorugine.* Portion of transverse section of a tentacle.

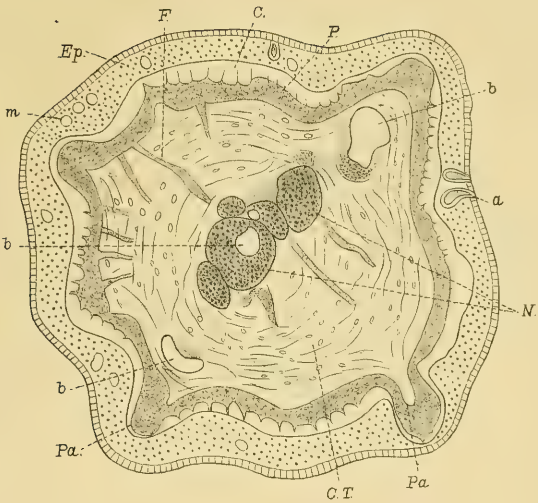
A, "Kolbe," in median section. A', another, cut to one side. *M.*, round form of mucous cell. *o.*, opening of the cavity of the "Kolbe." Other letters as in previous figures. Cam., oil-imm. $\frac{1}{12}''$, oc. × 5.

Fig. 9 *a*. *Blennius ocellaris.* Part of transverse section of tentacle.

M., a flask-shaped mucous cell. *n.*, its nucleus surrounded by the residual protoplasm. Other lettering as before. Cam., oil-imm. $\frac{1}{12}''$, oc. × 8.

Fig. 10. *B. gattorugine.* Isolated elements from the epidermis of the tentacle, treated with osmic acid.

A, "Kolben." B, round form of mucous cell, blackened with osmic acid. *c.*, cup-like cavity of Kolben. *n.*, eccentric nucleus of mucous cell. Cam. obj. $\frac{1}{6}''$, oc. × 8.



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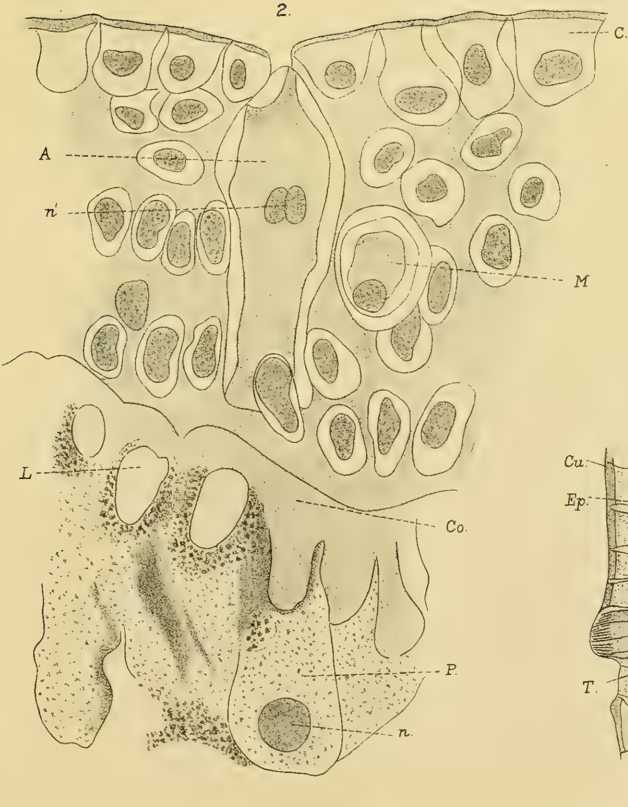

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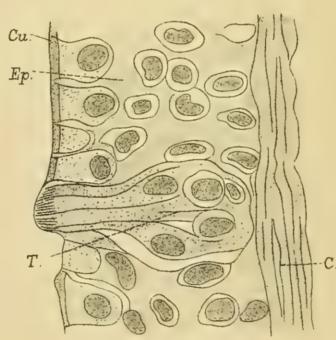

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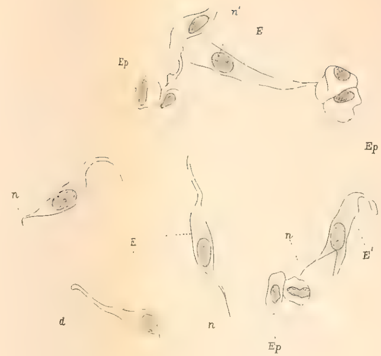

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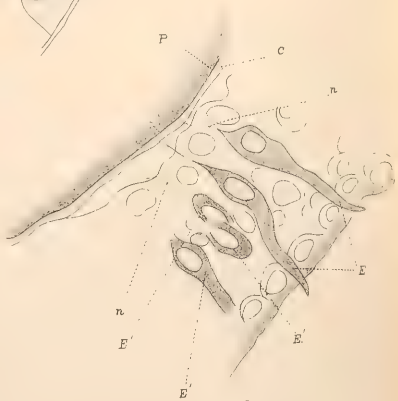

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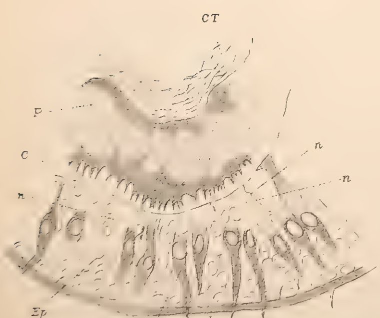

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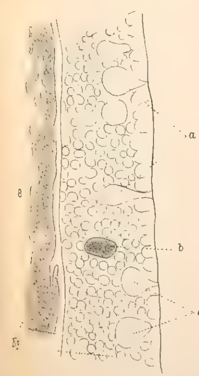

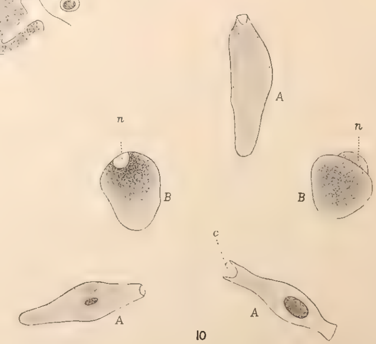

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TENTACLES OF BLENNIUS.